i2t monitoring

Translation of the "Original Dokumentation"
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Name: FKT_Ueberwachung_i2t_en

Version:

Version: 2019/45	
Change	**Letter symbol**
• Controller card KW-R27 added	STL

Previous version: 2018/44

Product version:

Product (AMK part no.)	**Firmware Version (AMK part no.)**
KW-R06 (O835) KW-R07 (O807) KW-R16 (O872) KW-R17 (O873)	AE-R05/R06 V1.10 2013/15 (204486)
KW-R24 (O901)	AE-R24 V2.03 2015/06 (205587)
KW-R24-R (O954)	AE-R24-R V2.11 2016/46 (206643)
KW-R25 (O902)	AE-R25 V2.03 2015/06 (205588)
KW-R26 (O903)	AE-R26 V2.03 2015/06 (205589)
KW-R27 (O957)	AE-R26 V2.12 2018/40 (207284)
KE, KEN, KES	KE-E03 V3.04 2013/03 (204405)
KE-xEx, KEN-xEx, KES-xEx	KE-E10 V4.02 2014/49 (205533)
iX / iC / iDT5 /	iX V1.03 2013/18 (204515)
iX(-R3) / iC(-R3) / iDT5(-R3) /	iX V2.08 2015/46 (206017)
ihXT /	ihX V1.00 2015/06 (205440)

Publisher:
AMK Arnold Müller GmbH & Co. KG
Gaußstraße 37 – 39,
D-73230 Kirchheim/Teck
Germany
Phone: +49 7021/50 05-0,
Fax: +49 7021/50 05-176
E-Mail: info@amk-group.com
Homepage: www.amk-group.com
Personally liable shareholder: AMK Verwaltungsgesellschaft mbH, Kirchheim/Teck
Registration court: Stuttgart HRB 231283; HRA 230681

1 I^2t counter

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / KE (N,S) / KE(N,S)-xEx / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

If the actual current exceeds the current rating, the difference between the actual current and the rating is determined. This value is multiplied with the overload duration; in addition, a frequency-dependant value c(f) is taken into consideration. (See formula below.)

The I^2t counter changes with the results of the measurement.

Triggering the I^2t monitor results in a withdrawal of the System ready message (SBM) to the respective module. In addition, an error message is generated (device or motor overload). When the measured, actual current is below the current rating, the I^2t counter decrements again.

The device/motor overload message is generated when 100% of the I^2t counter is reached.

ID32999 'Overload limit inverter' and ID114 'Overload limit motor' specify the time for the warning messages 2357 'Device overload warning' or 2359 'Motor overload warning', respectively, for each application.

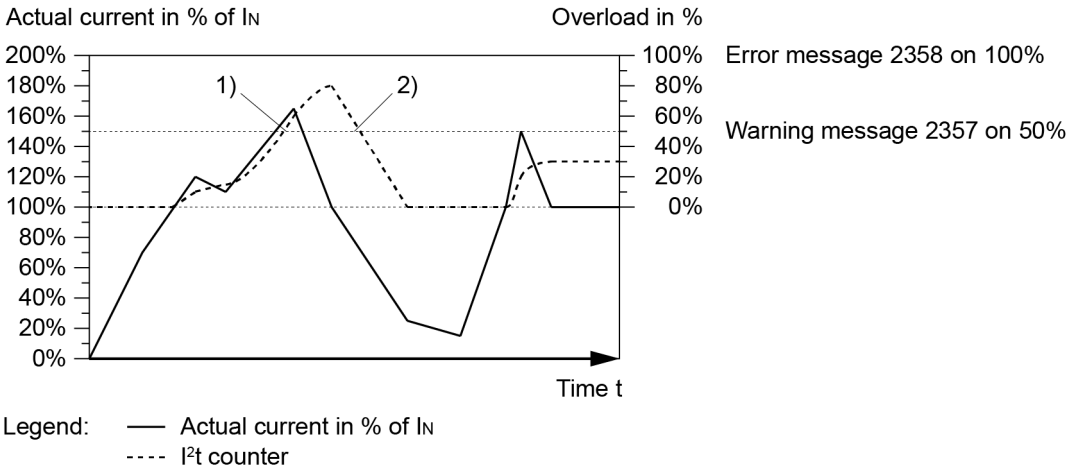
Special case:

For KW output in frequencies < 0.2 Hz in DC operation, on-time is reduced to 1 s.

Example, KW figure:

As soon as the actual current exceeds 100% of the current rating, the I^2t counter begins to increment. When the actual current measurement is below the current rating, the I^2t counter decrements. During operation at 100% current rating, the I^2t counter does not change.

ID32999 'Overload limit inverter' = 50%



1. Message 2357 'Device overload warning' is generated, and digital output code 33016 (inverter overcurrent warning) is set.
2. Digital output code 33016 is reset.

Calculation:

$I^2t = \sum(c(f) \times i^2(t) - i_N^2) \times dt$

c(f) = frequency of motor current
i = actual current (overcurrent)
i_N = nominal current
dt = overload time

2 I^2t monitor - power supply

Supported hardware:	KE(N,S) / KE(N,S)-xEx /

The I^2t monitor protects the power semiconductors (IGBTs) in the power supply from thermal overload.

The power supply calculates the maximum overload duration internally from the specifications.

2.1 Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID32999 1)	'Overload limit inverter'	Warning threshold inverter [%] (If ID32999 = 0, a threshold of 50 % is used)
ID33101 3)	'Display overload inverter'	Display of overload of the inverter [%]

1) The parameter value must be set specific to the application

3) Parameter value is automatically generated by the controller card

2.2 Startup instructions

Activation

The I^2t monitor for the power supply is always active.

Warning threshold

At ID32999 'Overload limit inverter', the operator may set the threshold (I^2t value, in [%]) for triggering diagnostic message 2349 'Inverter overload warning'. The default value for ID32999 'Overload limit inverter' is 50% device overload.

2.3 Development

Exceeding the overload threshold generates warning message 2349 'Inverter overload warning'. This does not affect the power supply.

When the I^2t counter [%] falls below the threshold value in ID32999 'Overload limit inverter', the warning message is reset.

If the I^2t counter reaches 100%, an error is generated. When receiving diagnostic message 2345 'Inverter overload error', the power supply shuts down. System ready message (SBM) and DC Bus Enable (UE) are withdrawn, and the DC bus voltage is reduced.

3 I^2t monitor - inverter

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

The I^2t monitor protects the power semiconductors (IGBTs) in the inverter from thermal overload.

The inverter module calculates the maximum overload duration internally from the specifications.

3.1 Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID32999 1)	'Overload limit inverter'	Warning threshold inverter [%] (If ID32999 = 0, a threshold of 50 % is used)
ID33101 3)	'Display overload inverter'	Display of overload of the inverter [%]

1) The parameter value must be set specific to the application

3) Parameter value is automatically generated by the controller card

3.2 Startup instructions

Activation

The I^2t monitor for the inverter is always active.

Warning threshold

At ID32999 'Overload limit inverter', the operator may set the threshold (I^2t value, in [%]) for triggering diagnostic message 2357 'Device overload warning'. The default value for ID32999 'Overload limit inverter' is 50% device overload.

3.3 Development

Exceeding the overload threshold generates warning message 2357 'Device overload warning'. This does not affect the drive.

In addition to the warning message, the device overload warning bit (code 33016) is set to “1”.

If required, the superordinate controller must trigger the desired response of the drive by evaluating the warning bit (code 33016).

When the I^2t counter [%] returns to a value below the threshold set in ID32999 'Overload limit inverter', the warning bit (code 33016) is also reset until such time as the threshold is exceeded again.

The warning message (intermittent LED on the controller card) remains on until the clear error (FL) command is activated.

At 100% overload (I^2t), Inverter On is withdrawn. The drive shuts down with error message 2358 'Device overload error', and the motor coasts to a stop.

The ID33101 'Display overload inverter' device overload indicator informs the operator about the degree of inverter overload in [%].

4 I^2t monitor - motor

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

I^2t monitoring protects the motor from thermal overload, for instance when the motor's thermal time constant is very low, as is the case with linear motors or motors without PTC thermistors for temperature monitoring.

4.1 Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID109 1)	'Motor peak current'	Maximum current of the motor [A] (ID109 is only effective if ID34167 'Terminal Inductance' is ≠ 0.)
ID114 1)	'Overload limit motor'	Warning threshold motor [%] (If ID114 = 0, a threshold of 50 % is used)
ID310 3)	'Overload motor'	Overload of the motor (with this parameter, the 'Overload motor' warning is assigned an identification number. The warning can be assigned to a real-time bit.)
ID32773 1)	'Service bits'	Bit 14: i^2t-Überwachung Motor See 'ID32773 'Service bits' bit 14' on page 9.
ID33102 3)	'Display overload motor'	Display of overload of the motor [%]
ID34096 1)	'Standstill current motor'	Standstill current of the motor [A]
ID34168 1)	'Time maximum current motor'	Time maximum current of the motor [s]

1) The parameter value must be set specific to the application

3) Parameter value is automatically generated by the controller card

4.2 Startup instructions

Activation

Other than the device monitor, the I^2t monitor for the motor needs to be activated in order to function.

Important requirement: ID34096 'Standstill current motor' $I_0 = 0$.

Otherwise the speed-dependent I^2t monitor is active (See 'Standstill current motor' on page 7.).

The I^2t monitor for the motor is activated in ID32773 'Service bits' bit 14. This monitor is switched off by default.

Warning threshold

ID114 'Overload limit motor' specifies the overload value (I^2t value, in [%]) for sending diagnostic message 2359 'Motor overload warning'. The default value for ID114 'Overload limit motor' is 50% motor overload.

4.3 Development

ID34168 'Time maximum current motor' specifies for how long the motor can be run with the value specified in ID109 'Motor peak current'.

Exceeding the overload threshold generates warning message 2359 'Motor overload warning'. This does not affect the drive.

In addition to the warning message, the ID310 'Overload motor' (configurable to a binary output) is set.

If required, the superordinate controller triggers the desired response of the drive by ID310 'Overload motor'.

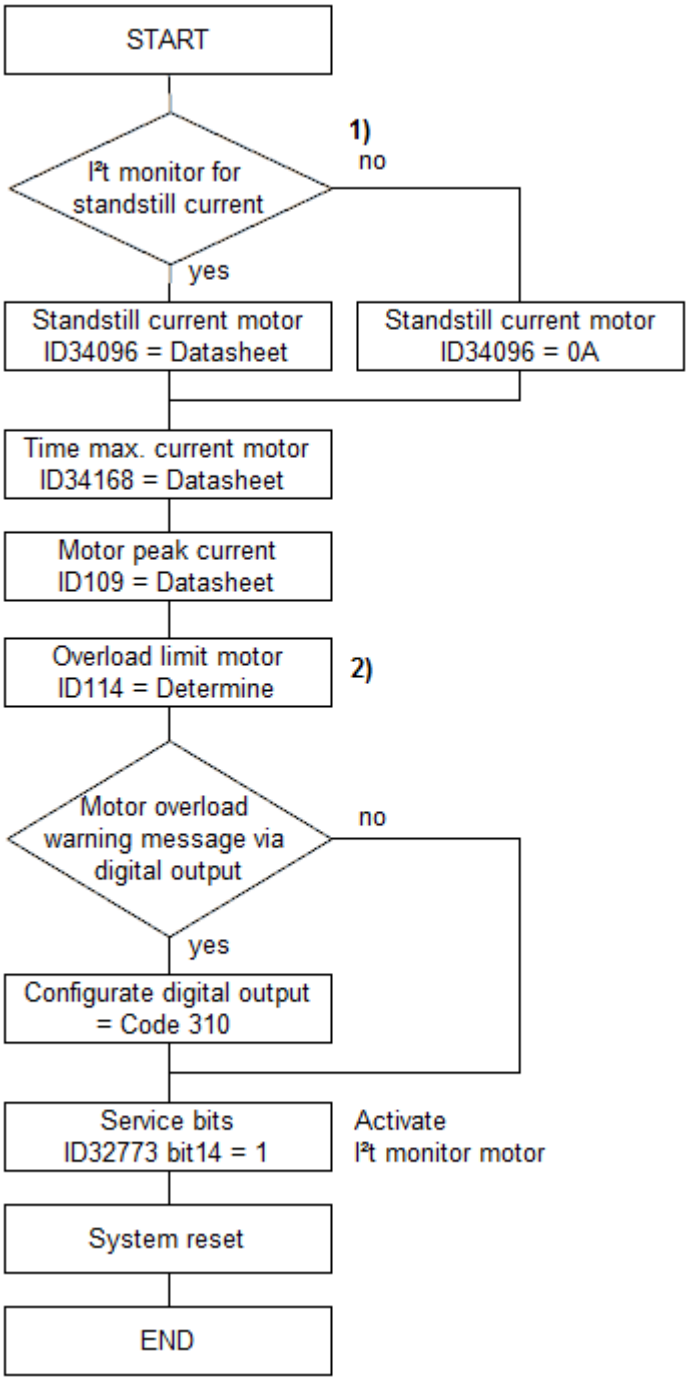
When the I^2t counter [%] returns to a value below the threshold set in ID114 'Overload limit motor', the ID310 'Overload motor' is reset.

At 100% overload (I^2t) an error is generated. The drive sends diagnostic message 2360 'Motor overload error'. After ID32782 'Deceleration ramp RF inactive', the motor is run down to zero speed, disables the IGBT trigger pulses and resets QRF.

The parameters ID34168 'Time maximum current motor' and ID109 'Motor peak current' can be used to adjust the I^2t monitoring of the thermal time constants of the motor.

The ID33102 'Display overload motor' informs the operator about the degree of motor overload in [%].

4.4 Configuration flowchart, I^2t monitor for the motor



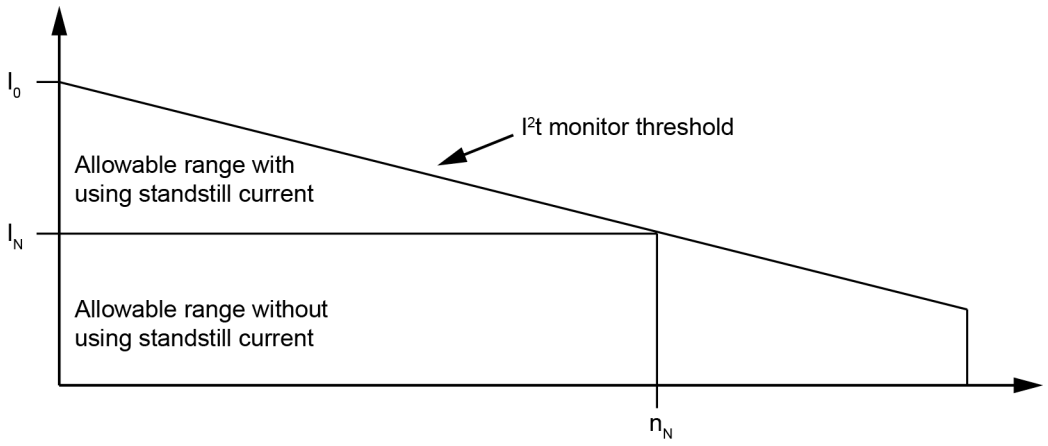
1) See 'Standstill current motor' on page 7.
2) See 'Motor overload threshold' on page 7.

4.4.1 Standstill current motor

At low speeds, some motors are able to receive currents greater than their rating without overheating.
In order to be able to define a higher overload threshold, the I^2t monitor for the motor is configurable dependent on speed.

Setting ID34096 'Standstill current motor' causes a new linear characteristic between I_0 and I_N. This is then used as the trigger threshold for the I^2t monitor for the motor.
For currents exceeding I_N the characteristic is extrapolated, maintaining the gradient.

If I_0 is set to zero, only I_N is used as a threshold (standard application).



4.4.2 Motor overload threshold

ID114 'Overload limit motor' determines the maximum allowable value for the I^2t counter before the message 2359 'Motor overload warning' is generated.

ID310 'Overload motor' is generated at the same time as the warning. When the I^2t counter returns below the value in parameter ID114 'Overload limit motor', ID310 'Overload motor' is reset until such time as the value is exceeded again.

ID34168 'Time maximum current motor' specifies the maximum allowable motor operating time for the maximum current specified in ID109 'Motor peak current'.

5 i^2t monitor - external component

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / KE (N,S) / KE(N,S)-xEx / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

Independent from the i^2t monitoring of the motor, an external component such as the motor cable or mains choke can be monitored.

5.1 Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID34193 1)	'Nominal current external component'	Nominal current of the external component [A] (If ID34193 = 0, the nominal current of the inverter ID112 is used)
ID34194 1)	'Peak current external component'	Maximum current of the external component [A] (If ID34194 = 0, the maximum current of the inverter ID110 is used)
ID34195 1)	'Peak current time external component'	Time for maximum current of the external component [s] (If ID34195 = 0, a time of 10 s is used)
ID34196 1)	'Treshold external component'	Warning threshold [%] (IF ID34196 = 0, a threshold of 50 % is used)
ID34197 3)	'Display external component'	Display of overload of the monitored component [%]

1) The parameter value must be set specific to the application

3) Parameter value is automatically generated by the controller card

5.2 Startup instructions

Activation

In order to activate the i2t monitoring of an external component, at least one of the parameters ID34193 'Nominal current external component' / ID34194 'Peak current external component' / ID34195 'Peak current time external component' must be set to a value not equal 0.
The other parameters will be set to their default values (See 'Relevant parameters' on page 8.).

Warning threshold

ID34196 'Treshold external component' is not relevant for activating the monitoring function. It just defines, at which threshold the warning message 1111 'Warning external component' is generated.
With ID34196 = 0, a threshold of 50 % is valid.

5.3 Development

If the overload of the external component reaches the value set in ID34196 'Treshold external component', a warning message is generated:
diagnostic message 1111 'Warning external component'.

When the overload reaches 100 %, the drive will be braked by the controller and the error message 1112 'Overload error external component' is generated.

Appendix

ID32773 'Service bits' bit 14

Bit no.	Condition	Meaning
14	0	i^2t monitoring of motor inactive
	1	i^2t monitoring of motor If the value in ID114 'Overload limit motor'is exceeded, the warning message 2359 'Motor overload warning' is generated and warning bit code 33074 'Collective warning' and ID11 is set. As soon as ID33102 'Display overload motor' = 100 % is reached, the controller enable is withdrawn internally, the drive is braked according to ID32782 'Deceleration ramp RF inactive' until coming to a standstill, the acknowledgement QRF is set to zero and the error message 2360 'Motor overload error' is generated. See ID109 'Motor peak current'. See ID34168 'Time maximum current motor'. Formula for calculating the overload time t_x with a current I_x: $k = \left[\left(\frac{ID109}{ID111}\right)^2 - 1\right] \times ID34168$ $t_X = \frac{k}{\left(\frac{I_X}{ID111}\right)^2 - 1}$